REMARKS/ARGUMENTS

1. Claims 1–5, 13 and 16–28 are pending in the application.

2. FIG. 1 and FIG. 2(a) to FIG. 2(f) were objected to as requiring a legend designating them as prior art. Applicant submits herewith corrected drawing sheet 1/4 and believes that the objection to the drawings is overcome.

3. Claims 1–5 and 20-24 were rejected under 35 U.S.C. 102(b) as being anticipated by Tomaru (JP 06-109936; English translation from JPO). Claims 13, 16–19 and 25-28 were rejected under 35 U.S.C. 103(a) as being unpatentable over Dutta (US 5,608,566) in view of Tomaru; claims 1-5 and 20-24 were rejected under 35 U.S.C. 103(a) as being unpatentable over Weidman (US 4,921,321) in view of Applicant's admitted prior art. Claims 13, 16-19 and 25-28 were rejected under 35 U.S.C. 103(a) as being unpatentable over Dutta in view of Weidman.

Rejection of claims 1–5 and 20-24 as being anticipated by Tamaru

4. The Examiner states: "Tomaru discloses a method of making an optical waveguide. The lower clad layer (bottom boundary) is deposited using polysiloxane (A) and the film of polysiloxane (B) are deposited as a core layer. The core layer is exposed to excimer laser light in the presence of oxygen to change the solubility and form a pattern (side boundary). The upper clad layer (top boundary) is then laminated to form the embedded three-dimensional waveguide. See the abstract and [0028]." Applicant points out that from Applicant's reading of Tomaru, the core layer, after photo oxidation, is chemically etched to remove any polysiloxane that would form the side walls. See FIG. 1(C) or FIG. 2(C). That is the core layer is used only to form the waveguide core 2a. Consequently the upper clad layer of polysiloxane also forms the side boundaries.

5. In Tomaru the core layer of polysiloxane is spun coated onto a lower clad layer of polysiloxane and heated to form a film that is selectively exposed to radiation through a mask in the presence of oxygen. The film is etched with a solvent so that only the exposed regions remain to form the core or clad of an optical waveguide. Another layer of polysiloxane is deposited over the exposed regions to form an upper clad layer and side boundaries of the waveguide core.

6. In claim 1 of the present application precursor waveguide material is deposited on a bottom boundary material. The precursor waveguide material is formed from a

two-component plasma reaction wherein the first component of the two-component plasma reaction comprises a non-carbon containing and non-oxygenated silicon donor, and a second component comprises a non-silicon containing and non-oxygenated organic precursor. The precursor waveguide material comprises (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix that does not contain an appreciable amount of silicon. Side boundaries are formed from the precursor waveguide material by selectively photo-oxidizing a region of the precursor waveguide material adjacent to a waveguide core by exposing the region of the precursor waveguide material to a radiated electromagnetic energy in the presence of oxygen whereby primarily the silicon in the (Si-H) and (Si-Si) fragments oxidize to form the side boundaries of the waveguide core.

7. Tomaru teaches spin coating a layer of <u>polysiloxane photoresist</u> on a lower clad layer of polysiloxane; fixing the photoresist; and exposing a masked region of the photoresist to radiation in the present of oxygen in what appears to be an attempt to primarily enhance oxygen bonding to silicon in the deposited polysiloxane to change the solubility (index of refraction) of the formed waveguide core. Tomaru removes the non-photo oxidized polysiloxane photoresist by etching, and overlays the remaining waveguide core with an upper clad layer of spin coated polysiloxane. Polysiloxane is a polymer that contains alternate silicon and oxygen atoms and is defined by the formula $(R_2SiO)_n$ where R can be H or an alkyl or aryl group. See also formula I and II in Tomaru. Polysiloxane is a polymer that does <u>not</u> contain (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix that is produced from a two-component plasma reaction as recited in claim 1. Applicant submits that oxidation of a polysiloxane depends upon oxygen bonding with Si or R forming the polysiloxane, which produces a photo oxidized product that does not anticipate the product by process of claim 1 of the present application. Furthermore Tomaru uses the photo oxidized polysiloxane exclusively for the waveguide core; in claim 1 the side boundaries of the precursor waveguide material is photo oxidized and the non-photo oxidized precursor waveguide material is used as the waveguide core. Tomaru does not form the side boundaries of the waveguide core from the layer of polysiloxane that is photo oxidized and etched to form

the core; in Tomaru the third layer of polysiloxane forms not only the top clad of the waveguide but also the side boundaries. Applicant submits that claim 1 is not anticipated by Tomaru. Claims 2-4 are dependent from claim 1; claim 5 is dependent from claim 4. Applicant submits that claims 2-5, dependent directly or indirectly from claim 1, are not anticipated by Tomaru for the reasons set forth above for claim 1.

8. In claim 20 of the present application the waveguide core is formed from the precursor waveguide material by selectively photo-oxidizing a region of the precursor waveguide material adjacent to a waveguide core by exposing a region of the precursor waveguide material to a radiated electromagnetic energy in the presence of oxygen whereby primarily the silicon in the (Si-H) and (Si-Si) fragments oxidize to form the waveguide core that is bounded on its sides by the non-photo oxidized precursor waveguide material. Applicant refers to discussion of Tomaru relative to claim 1 in paragraphs 5 and 7 above. Applicant submits that claim 20 is not anticipated by Tomaru. Claims 21-23 are dependent from claim 20; claim 24 is dependent from claim 23. Applicant submits that claims 21-24, dependent directly or indirectly from claim 20, are not anticipated by Tomaru for the reasons set forth above for claim 20.

<u>Rejection of claims 13, 16-19 and 25-28 as being obvious over Dutta in view of Tomaru</u>

9. The Examiner states: "Dutta teaches a waveguide structure which is capable of switching a signal in any one of four directions. A multiple quantum well structure 5 (barrier) is sandwiched between upper and lower waveguides 4 and 6. The upper and lower waveguides are sandwiched between upper and lower cladding layers 3 and 7 (col.1, 13-16, col.2, 49-51, col.3, 50-61). Dutta however does not disclose that the waveguide (core) layers 4 and 6 comprise silicon and organic components and one photo-oxidized region. Tomaru teaches that polysiloxane is a good material for use in a waveguide because it has reliable optical properties and may be easily patterned in the presence of oxygen in order to form the waveguide core [0028]-[0030]. It would have been obvious to one of ordinary skill in the art to use polysiloxane for the waveguide material layer in the method of Dutta because Tomaru teaches that polysiloxane has reliable optical properties and may be easily patterned in the presence of oxygen in order to form the waveguide core."

10. In claim 13 of the present application each of at least two waveguide core layers comprises (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix. At least one region of each waveguide core layer is selectively photo-oxidized by exposing the region to a radiated electromagnetic energy in the presence of oxygen whereby primarily the silicon in the (Si-H) and (Si-Si) fragments oxidize.

11. Dutta teaches a multi-layered waveguide structure formed from "a composite of AlGaAs comprising the cladding and waveguide core layers" (col.4, lines 4 and 5). Dutta does not teach waveguide core layers comprising (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix. Nor does Dutta teach selectively photo oxidizing selective regions of the core layers. Applicant's remarks regarding Tomaru and present claim 1 in paragraphs 5 and 7 above, are referred to with respect to the present rejection of claim 13. Applicant submits that the waveguide core layers comprising (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix of claim 13 is not obvious over the multi-layered, composite AlGaAs waveguide structure of Dutta in view of the polysiloxane waveguide core taught by Tomaru. Claims 16-18 are dependent from claim 13; claim 19 is dependent from claim 18. Applicant submits that claims 16-19, dependent directly or indirectly from claim 13, are not obvious over Dutta in view of Tomaru for the reasons set forth above for claim 13.

12. In claim 25 of the present application each of the at least two layers of precursor waveguide material comprises (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix wherein a waveguide core is formed by selectively photo-oxidizing a first region of the precursor waveguide material to form the waveguide core, and side boundaries are formed by selectively photo-oxidizing a second region of the precursor waveguide material. For the same reasons discussed above in paragraph 11 regarding claim 13, Applicant submits that the multiple layers of selectively photo-oxidized precursor waveguide material comprising (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix as

recited in claim 25 are not obvious over Dutta in view of Tomaru. Claims 26-27 are dependent from claim 25; claim 28 is dependent from claim 27. Applicant submits that claims 26-28, dependent directly or indirectly from claim 25, are not obvious over Dutta in view of Tomaru for the same reasons as claim 25.

<u>Rejection of claims 1-5 and 20-24 as being unpatentable over Weidman in view of Applicant's admitted prior art.</u>

13. The Examiner states: "Weidman teaches an amorphous silicon material which is useful in the fabrication of optical devices. An optical device, including a waveguide (side) region, may be formed which comprises a region of a silicon-containing material formed by the photo-oxidation of polysilyne wherein the silicon-containing region has a refractive index that differs from adjacent regions of the waveguides (abstract, col.4, 46-col.5,19, col.8, 35-62). While Weidman does not explicitly disclose the specifics of waveguide structure, such as the bottom boundary and top boundary layer, the applicant teaches on p.2-3 that a conventional waveguide structure includes in addition to the waveguide core and side boundary layers, a top boundary and bottom boundary layer. It would have been obvious to one of ordinary skill in the art to have the optical waveguide in the method of Weidman to also include in addition to the waveguide core and side boundary, a top boundary and a bottom boundary layer, because the applicant's admitted prior art teaches that these are features are present in a conventional waveguide structure."

14. Weidman teaches waveguide production with a material denominated as "polysilyne" that is spun coated on a substrate. Weidman defines a polysilyne as a polymer with the formula $(SiR_x)_n$ with $0.7 \leq x \leq 1.3$ and R is an organic substituent (col.2, 15-20). Polysilanes are produced by reduction of an alkyl or aryl trihalosilane (col.2, 47-50). In claim 1 of the present application the precursor waveguide material comprises (Si-H) and (Si-Si) low molecular weight fragments, interstitially situated within a substantially non-photosensitive organic polymer matrix, that are formed from the two-component plasma reaction of a non-carbon containing and non-oxygenated silicon donor, and a non-silicon containing and non-oxygenated organic precursor. Weidman's polysilynes are substantially silicon atoms bounds to an organic subsituent and to three other silicon atoms that are produced from the reduction of alkyl or aryl

trihalosilanes. The disclosed Weidman polysilyne clusters of each silicon atom bound to at least three other silicon atoms neither anticipate, nor make obvious, the (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix of the present invention. Applicant submits that claim 1 is not obvious over polysilanes as taught by Weidman in view of the admitted prior art. Claims 2-4 are dependent from claim 1; claim 5 is dependent from claim 4. Applicant submits that claims 2-5, dependent directly or indirectly from claim 1, are not obvious over Weidman in view of the admitted prior art for the reasons set forth above for claim 1.

15. Applicant submits that the precursor waveguide material comprising (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix as recited in claim 20 is not obvious over the polysilyne material as taught by Weidman in view of Applicant's admitted prior art for the reasons set forth above in paragraph 14 for claim 1. Claims 21-23 are dependent from claim 20; claim 24 is dependent from claim 23. Applicant submits that claims 21-24, dependent directly or indirectly from claim 20, are not obvious over Weidman in view of Applicant's admitted prior art for the reasons set forth above for claim 20.

<u>Rejection of claims 13, 16-19 and 25-28 as being obvious over Dutta in view of Weidman</u>

16. The Examiner recites the teachings of Dutta and Weidman as set forth above in paragraphs 9 and 13, and concludes: "It would have been obvious to one of ordinary skill in the art to use polysilyne for the waveguide material layers in the method of Dutta because Weidman teaches that polysilyne has a large drop in refractive index when photo-oxidized and is therefore able to produce optical waveguide structures with high resolution."

17. Applicant refers to Applicant's remarks in paragraphs 11 and 14 regarding Dutta and Weidman prior art. Applicant submits that the multiple waveguide core layers comprising (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix as recited in claim 13 are not obvious over Dutta in view of Weidman. Claims 16-18 are dependent from claim 13; claim 19 is dependent from claim 18. Applicant submits that claims 16-19,

dependent directly or indirectly from claim 13, are not obvious over Dutta in view of Weidman.

18. For the same reasons discussed above in paragraph 17 regarding claim 13, Applicant submits that the multiple layers of precursor waveguide material comprising (Si-H) and (Si-Si) low molecular weight fragments interstitially situated within a substantially non-photosensitive organic polymer matrix as recited in claim 25 are not obvious over Dutta in view of Weidman. Claims 26-27 are dependent from claim 25; claim 28 is dependent from claim 27. Applicant submits that claims 26-28, dependent directly or indirectly from claim 25, are not obvious over Dutta in view of Weidman for the same reasons as claim 13.

19. Applicant respectfully requests reconsideration and allowance of all pending claims.

Respectfully submitted,

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